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Images of twins and the notion of the genetic program in the school textbooks of Biology. A comparative study held among 15 countries.

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Abstract

Genetic concepts have been strongly evolved during these last ten years, and have been found less connected to reductionist or hereditarist values.
The aim of the specific research was to analyze and identify if the current school textbooks of biology ensue this progress, in the way the topic "human genetics" is taught in the textbooks of 15 different countries. Results show that the notion of the genetic program remained central in some countries, while it fades behind the notion of genetic information in some others. In addition, almost all the twins' pictures demonstrate the following pattern: they are identically dressed and they have the same hairstyle, which gives evidence of a strong obstinacy of a determinist reductionist ideology.

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SYNOPSIS:

Images of twins and the notion of the genetic program in the school textbooks of Biology. A comparative study held among 15 countries.

INTRODUCTION

During the first half of the 20th century, the development of genetics occurred within the scientific societies of "genetics and eugenics ". The idea of an inevitable genetic determinism arose, following by an eugenist ideology aiming to improve the human "races". Debates placed the upholders of the nature against those of the nurture carried out till the end of century, marking durably the minds of the teachers and their students. These debates widely leaned on some "studies" based on identical twins. While Burt (1961) claimed that his research (which turned out to be a fraud: Lewontin, et al, 1984) would prove that separate twins had in a percentage of an 80 % the same intellectual ability (intelligence), Schiff et al. (1982) proved that adopted children had an IQ corresponding to that of their foster parents. By the same time, the psychologist Zazzo (1984) described "the paradox of the twins": identical twins, physically similar, tend to differ more by their respective characters than fraternal twins or brothers or sisters that are not twins..

In the end of 20th century, while media continued to cast propositions (transformed into spectacular events) on the genes of the shyness, the violence, the obesity or the intelligence, the biologists claimed that debate between innate and acquired was scientifically obsolete, because there is an inevitable interaction between the two: the genotype and the influence of the environment are each 100 % necessary (Jacquard 1972, Stewart 1996, Jacquard and Kahn 2000).

By the 1999 Atlan claimed “the end of all genetics" (see also Kupiec and Sonigo 2000). First results on the sequencing of the human DNA (special volume of Nature and of Science in February, 2001) worsened the thesis of a simple genetic determinism on the intellectual performance of the man. All the human beings have 99,99 % of their genes identical.

The notion of "genetic program” is central in the genetic education at schools (at least in France and in Tunisia: Abrougui, 1997). It appeared as questionable, appointed with an hereditarist ideology (Abrougui and Clément 1997, Clément and Forissier, 2001). Atlan in 1999 suggested its replacement by a more neutral expression on the ideological plan, and more correct scientifically: the “genetic information”.

The notion of epigenesis, which was already widely used for the cerebral epigenesis (Changeux, in 1983), is now more and more utilized in molecular biology, in particular in order to express that the epigenetic process has a significant role in every phase of DNA’s activity, from self-repair (Friedeberg, 2001) to protein synthesis (Morange 2005a, 2005b). For instance, results of Fraga et al., 2005 illustrate that in 35% of monozygous twins studied there were differences in epigenetic patterns on the DNA.

AIMS AND METHODOLOGY

These modifications of the main concepts of genetics, and their interactions with citizen values, made us to select Human Genetics as one of the 6 topics of the European project Biohead-Citizen ("Biology, Health and Environmental Education for better Citizenship") to analyze at the present time how this specific topic is taught in several countries. Up to which point is the exceeded notion of genetic program still taught? Is there any obvious indication of the removal of the notion genetic programme and its replacement of the notion of genetic information?

Finally, analysed chapters that deal with the human genetics do they still carry tracks of a hereditarist vision, or of a reductionist ideology (in Canguilhem's sense on 1981: reduction of the biological complexity to some molecular determinism)?

We will analyse recognizable conceptions in textbooks as interactions between scientific knowledge (K), values and social practices (P): Clément's model of KVP (1998; 2004; 2006).

Are there implicit values in the chapters of textbooks dealing with the human genetics? We will focus on two indicators:

1 -Image representation of the twin births in textbooks.

Are the images suggest that the twins have the same character, the same clothes, tastes and behaviour or, on the contrary, illustrate the paradox of the twins who tend to differ by their characters as clothing and socio-cultural appearances?

2 - Occurrences of the expressions "genetic program" and "genetic information". These terms are indeed significant, showing if the textbooks tend to be or not in break with the era until then dominant (including at the school) of “all genetics” persuading that we would be completely programmed by our genes (what sub-aims an fatalist ideology).

The same grid, using these two indicators, has been used in the different countries involved in the research project Biohead-Citizen.
Firstly for each country it was important to be verified in which school level human genetics are being taught by referring to their syllabus, and then to analyse the corresponding textbooks.
The results on twins’ images, and occurrence of expressions "genetic program" or "genetic information" were obtained by each team from the analysis of the following textbooks: Portugal (4 textbooks), France (9 textbooks), Germany (3), Lebanon (4), Tunisia (3), Finland (2), Malta (2), Morocco (2), Senegal (1), Italy (9), Lithuania (3), Hungary (3), Rumania (1), Cyprus (2), Estonia (2).

RESULTS

Genetic program and/or genetic information?

For some countries, such as France, the use of the term genetic program and of the term genetic information depends strongly on the school level. For the pupils of 14-15 years, the notion of “genetic program“ is very frequent and is highly in majority (figure 1). In the textbooks of the two following years it is used more rarely (around 20 % of occurrences, in relation to 80 % of occurrences of “genetic information "),and it even disappears in the textbook of Terminal (the last year of secondary school, 17-18 years old) where it only mentions the notion of genetic information (figure 1).
A similar progression of the notion “genetic information” was observed in the Lebanese textbooks. This notion is present at 67% in textbooks for the pupils of 13-14 years old, furthermore it is most frequently observed in the textbooks for students aged 14-15 (92 % for science and 100 % for humanity).
However, textbooks for the last level of education rarely mention these expressions. In Moroccan textbooks this progression is less visible. In the first level, where for students 13-14 years old, the percentage of “genetic program” occurrence is 100%. In the following level, (17-18 years old), the notion of genetic information comes into sight but only in a small a small percentage (26%) .

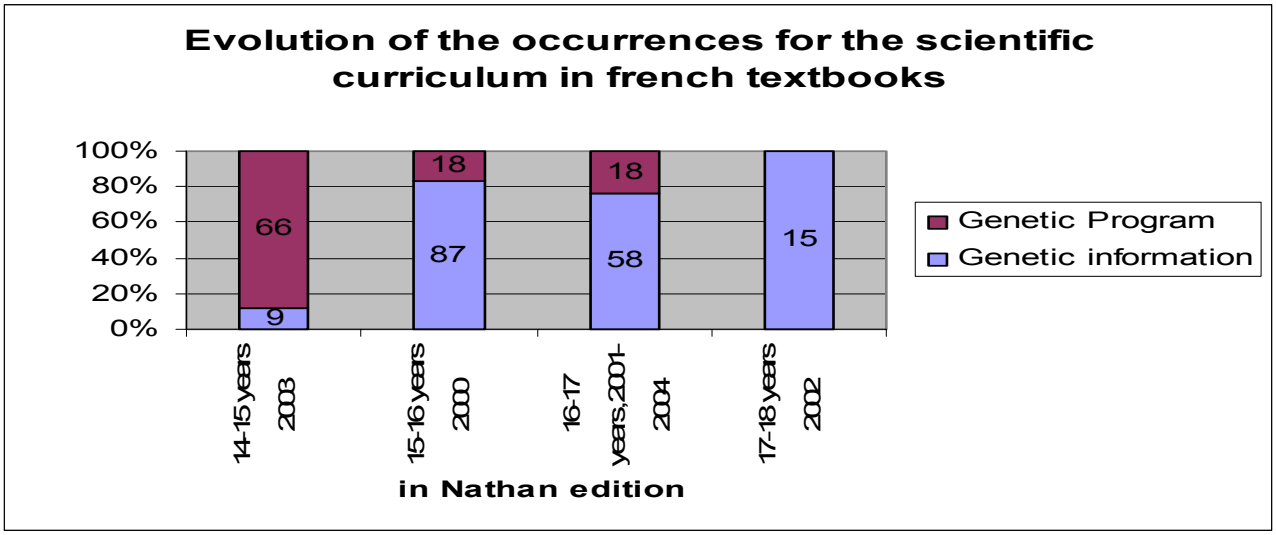

Figure1: Evolution of the occurrences for the scientific curriculum in French textbooks

On the other hand in Portugal, and in Malta the expression of genetic information is never present in textbooks and in Finland it is rarely present: only 3 occurrences in a total of 73. The notion of "genetic program" is clearly dominant in these countries.
Tunisia, Cyprus and Lithuania show a tendency to be the exceptions, there is no presence of "genetic program" throughout their curriculum and textbooks use exclusively the term of “genetic information ".

Romania and Senegal are the only countries that teach genetics on a single level (respectively, 17-18 years and 18-19 years old). The use of “genetic program" in Romanian textbooks is minimal (3 times, against 14 for “genetic information”).
In Senegal, the number of pages dedicated to genetics is low and contains only two occurrences for “genetic information” and only one for “genetic program”.
For Hungary, Italy and Estonia, human genetics is present at several levels but none of the two expressions is used and neither the existence of equivalent expressions.

To sum up, the presence of those expressions differs from one country to an other. While some persist on the notion of “genetic program” (propagating so, even without to it adhering consciously, implicit ideological of this expression), this notion tends to become blurred in some countries (France, Lebanon) or even to disappear (Tunisia, Cyprus, Lithuania).

Twins' images.
Among the 14 representatives images of the twins found in the different textbooks, 10 represented twins who have exactly the same hairstyle, the same clothes. Among the 4 images showing differences, 3 are fraternal twins' photos and 1 is representing identical twins (Hatier, France, 14-15 years old). All these twins' images (except a single exception) illustrate a simple and direct relation between genotype and phenotype, and suggest that genes would steer much more than physical resemblance: also tastes, choices of hairstyle or clothes, attitudes and behaviour. This states the conception that the parents have, because most of these twins are very young and are apparently dressed by their parents. A hereditarist implicit ideology is conveyed by these images, and this appears in all the countries where textbooks contain twins' illustration.

In conclusion, the evolution of the conceptions in the textbooks as for the notion of “genetic program", which is increasingly replaced by the notion of “genetic information”, does not come along with a disappearance of the hereditarist ideology, which spectacularly stays present with the analyzed twins' images.

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